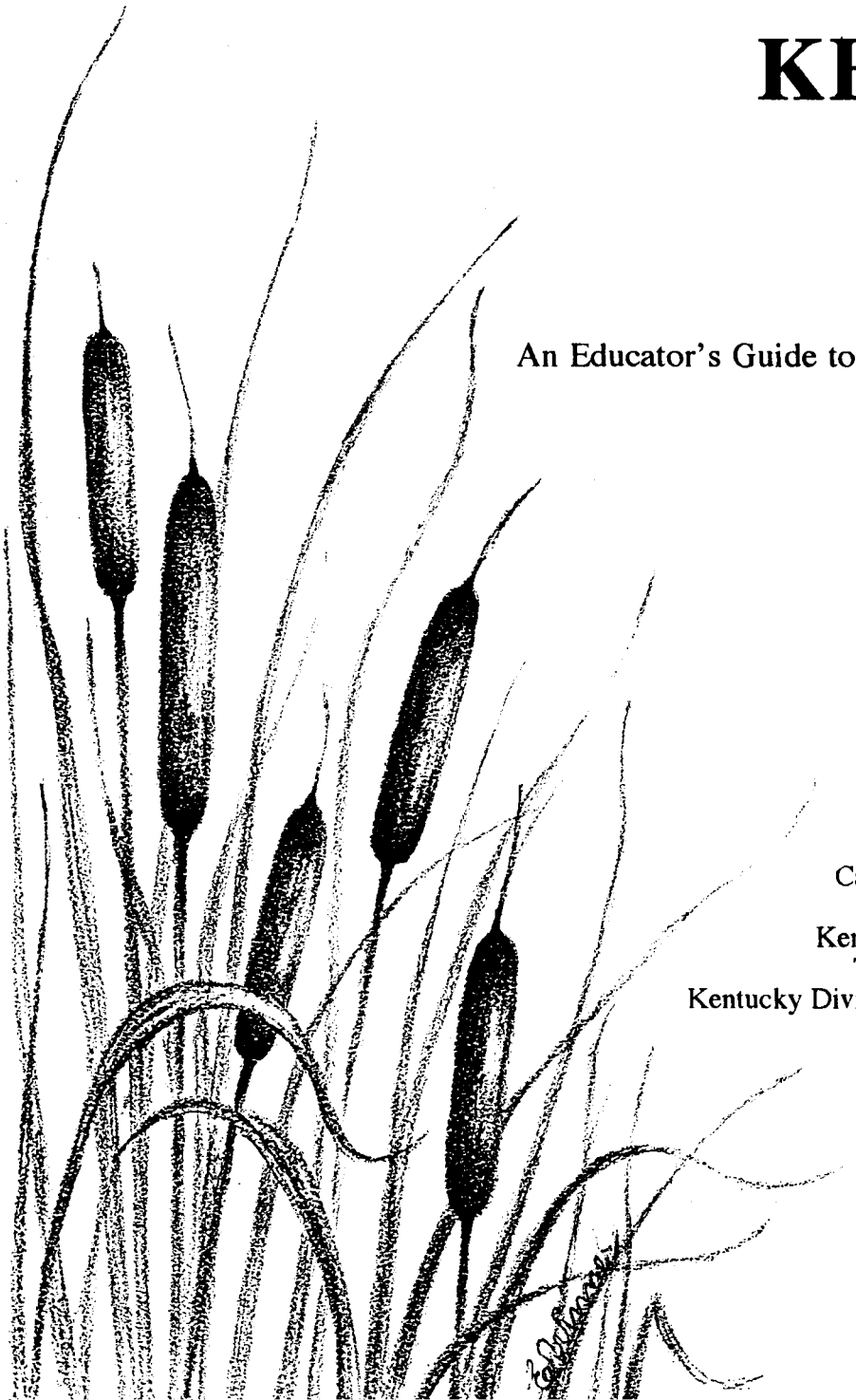
SPLASHING IN KENTUCKY!



An Educator's Guide to Nonpoint Source Water Pollution

Cathy L. Neeley, compiler

Kentucky Waterways Alliance
THE EARTH MOBILE
Kentucky Division of Water, Nonpoint Source Section
1998

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CONTENTS

INTRODUCTION

In compliance with a 319 grant from the Nonpoint Source Section of the Kentucky Division of Water, the Kentucky Waterways Alliance contracted with Cathy L. Neeley (geologist, environmental educator, and creator of THE EARTH MOBILE) for the compilation of this manual. It contains hands-on activities relating to Kentucky's water and nonpoint source pollution problems and will be distributed to teachers of all grade levels and to citizen groups.

This manual is a useful tool for the enhancement of water-quality knowledge and skills and to motivate citizenry to resolve the water quality issues facing it. Participants will gain an appreciation of the environmental sensitivity of water quality, explore the relationships of hydrologic components within a watershed, understand how human activities can affect the watershed, and learn responsible water resource management.

The activities are set up for groups of 20-25, mostly as small group work; however, a few activities require individual work, and some are teacher or leader demonstrations. Appropriate grade levels range from Kindergarten (K) to Adult (A), as noted for each activity. The equipment needed for the activities is usually items that can be easily obtained. For information on the availability of water quality test kits contact local Water Watch groups, Cooperative Extension Service, Natural Resources Conservation Service (Soil Conservation Service), THE EARTH MOBILE, or Kentucky Water Watch. Topographic maps can be borrowed from the EARTH MOBILE or purchased from the Kentucky Geological Survey. The cited references and references listed as other resources are available on loan from THE EARTH MOBILE. Most of the activities are interdisciplinary, covering such subjects as art, drama, economics, geography, health, history, language arts, literature, math, science, and social studies. Teachers may copy pages from this manual for classroom use.

The activities comply with the North American Association for Environmental Education (NAAEE) Guidelines for Environmental Education Materials (North American Association for Environmental Education, 1996) and the Learning Goals and Academic Expectations of the Kentucky Education Reform Act (KERA). The KERA goals and expectations met are listed for each activity and include:

Goal 1 - The application of basic communication and math skills:

1.1	Accessing information and ideas	1.8	Measuring
1.2	Reading	1.10	Classifying
1.3	Observing	1.11	Writing
1.4	Listening	1.12	Speaking
1.5	Quantifying	1.13	Visual arts
1.7	Visualizing	1.15	Movement

Goal 2 - The application of core concepts in science, mathematics, social studies, the arts and humanities, practical living studies and vocational studies:

2.1	Nature of scientific activity	2.11	Change
2.2	Patterns	2.14	Democratic principles
2.3	Systems and interactions	2.18	Economic systems
2.4	Models and scale	2.19	Relationship of geography to human activity
2.8	Math procedures		
2.9	Space and dimensionality	2.24	Aesthetics
2.10	Measurement	2.33	Community health systems

Goal 3 - Becoming a self-sufficient individual:

3.6	Ethical values
3.7	Independent learning

Goal 4 - Becoming a productive group member
- 4.1 Interpersonal skills
- 4.2 Productive team membership
- 4.4 Rights and responsibilities for self and others
- 4.6 Open mind to alternative perspectives

Goal 5 - Thinking and problem solving
- 5.1 Critical thinking
- 5.2 Creative thinking
- 5.3 Conceptualizing
- 5.4 Decision making
- 5.5 Problem solving

Goal 6 - Making connections with knowledge across all subject areas:
- 6.1 Applying multiple perspectives
- 6.2 Developing new knowledge
- 6.3 Expanding existing knowledge.

This manual contains selected activities from a vast pool of information and by no means contains a comprehensive list of resources. Much more literature is available on water and water pollution from various sources including:

- Kentucky Waterways Alliance 502-524-1774 stella@scrtc.blue.net
- THE EARTH MOBILE 606-625-9232 glyneele.acs.eku.edu
- Kentucky Division of Water 502-564-3410
  - Drinking Water
  - Groundwater
  - Nonpoint Source Pollution
  - Watersheds
  - Water Watch - http://www.state.ky.us./
  - Wetlands
  - Water Conservation
- Kentucky Division of Air Quality 502-573-3382
- Kentucky Division of Waste Management 502-564-6716
- Kentucky Department of Fish and Wildlife 502-564-4336
- Kentucky Division of Forestry 502-564-4496
- Kentucky Geological Survey 606-257-5500
- Kentucky Association of Environmental Educators 606-578-0312
- Kentucky Environmental Education Council 1-800-882-5271
- Natural Resources Conservation Service (Soil Conservation Service)
- Cooperative Extension Service
- Local Water Watch groups

ACKNOWLEDGMENTS

The resources used to compile this manual were provided by THE EARTH MOBILE. The cover artwork was designed by Esther P. Winner, and the rest were designed by Chris Neeley except where otherwise noted. Office space, computers, copiers and long distance phone calls were provided by the Geology Department at Eastern Kentucky University.

Special thanks goes out to these reviewers:

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Judith Peterson - Kentucky Waterways Alliance
Sue Reeves - Teacher
Sally Smathers - Madison County Solid Waste Coordinator
Julie Smithers - Kentucky Association of Environmental Educators
Catarina Vieira - Teacher

WATER DISTRIBUTION

Between two-thirds and three-fourths of the earth's surface is water, a resource that is thought of as being limitless.

However, of all the water on the earth:

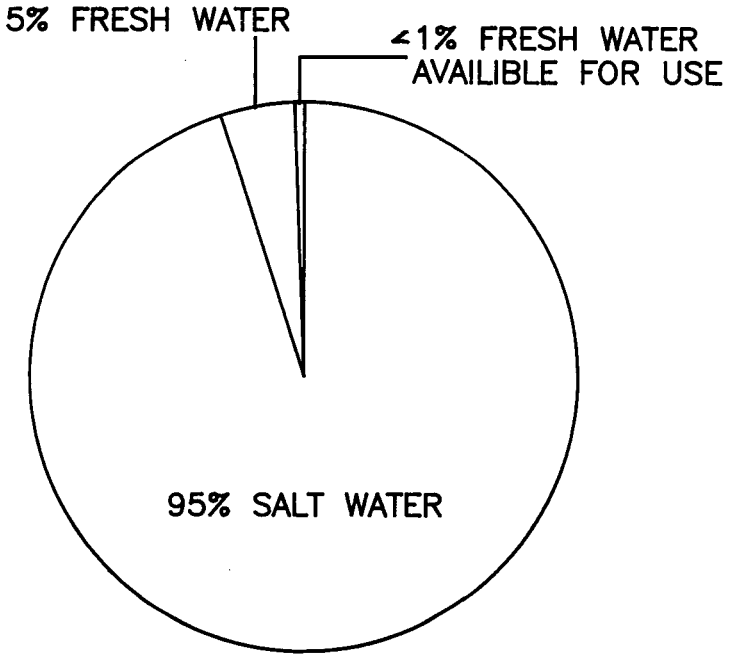
- more than 95 percent is in the oceans
- the remaining 5 percent is fresh water, most of which is contained in the polar ice sheets
- of this 5 percent, less than 1 percent is the freshwater available for use - not used up but recycled and shared throughout the world! (Florida Cooperative Extension Service)

Thus, we have a responsibility to conserve and protect this water resource by using it wisely and reducing pollution.

Water is found throughout Kentucky in rivers, lakes, streams, and under the ground. The state also receives about 48 inches of precipitation each year (Wunsch, Carey, and Dinger, 1993). What happens to this precipitation once it hits the ground affects every living thing. Unfortunately human activities play a major part in the pollution of our water resources.

Learning to modify our activities for the protection of our water quality is a major step toward clean water in Kentucky!

The following activities illustrate the distribution of water in the world.



WATER, WATER, EVERYWHERE, AND ONLY A DROP TO DRINK

GRADES: K-A
SUBJECT: Geography, Social Studies
SKILLS: Comprehending, discussing, visualizing
DURATION: 15 minutes
SETTING: Indoor
KERA ACADEMIC EXPECTATIONS: 1.3, 1.4, 2.4, 3.6, 5.3, 6.2, 6.3

OBJECTIVE:
To gain an understanding of the importance of water quality protection.

METHOD:
Teacher or leader demonstration of the available amount of fresh water on earth.

MATERIALS NEEDED:

- Gallon jug of water (use a few drops of food coloring to make it more visible)
- 2 clear 8 oz. cups
- Eyedropper

PROCEDURE:

- Show students the gallon of water - this represents all the water on earth.
- Fill one of the cups half full, using the water from the jug - the water in the cup represents all the fresh water on earth and the water remaining in the jug represents all the salt water.
- Remove a small amount of water from the cup using eyedropper, release one drop into the second cup - this drop represents the **useable** freshwater.

EVALUATION:
This demonstration shows graphically how fragile our water resources are and why we should be concerned about how human actions affect water quality.

- Where is most of the world's fresh water? (polar ice sheets)
- What are some other sources of fresh water? (Rivers, lakes, streams, ponds, groundwater, etc.)
- Where does the local community gets its fresh water? (River, reservoir, groundwater, etc.)

(Adapted from Florida Cooperative Extension Service)

RECYCLED

GRADES: 4-A
SUBJECT: Literature, Science
SKILLS: Communicating, listening or reading
DURATION: 15 minutes
SETTING: Indoor or outdoor
KERA ACADEMIC EXPECTATIONS: 1.2, 1.4, 2.2, 2.24, 6.1, 6.3

OBJECTIVE:
To gain an understanding that all life uses the same water.

METHOD:
Read the poem "Recycled."

MATERIALS NEEDED:

- A glass of water for all participants
- Worksheet - "Recycled"

PROCEDURE:

- Hand out glass of water to all participants; don't drink yet!
- Read poem to class or have class read parts.
- Now you can drink!

EVALUATION:
This activity demonstrates that we all use the same water because it is recycled.

- Where does the local community gets its fresh water? (lakes, rivers, wells, etc.)
- Did any community use this water first? (example: towns located upstream)
- If community uses groundwater, how did the water get into the ground? (infiltration of rain and snow)
- Where does the wastewater go? (sewage treatment plant, septic system)
- What is the cycle of water use in the community? (example: river to water treatment plant to homes to sewage treatment plant back to river - if community uses septic tanks, water returns to the groundwater)
- What community does the recycled water go to next? (towns located downstream, other communities using groundwater)

EXTENSIONS:
Write a poem or story about recycled water in local community.

(adapted from Crum, 1990)

WORKSHEET - "RECYCLED"

The glass of water you're about to drink
Deserves a second thought, I think,
For Avogadro*, oceans and those you follow
Are all involved in every swallow.

The molecules of water in a single glass
In number, at least five times, outclass
The glasses of water in stream and sea,
Or wherever else that water can be.

The water in you is between and betwixt,
And having traversed is thoroughly mixed,
So someone quenching a future thirst
Could easily drink what you drank first!

The water you are about to taste
No doubt represents a bit of the waste
From prehistoric beast and bird ---
A notion you may find absurd.

The fountain spraying in the park
Could well spout bits from Joan of Arc,
Or Adam, Eve, and all their kin;
You'd be surprised where your drink has been!

Just think! The water you cannot retain
Will someday hence return as rain,
Or be beheld as the purest dew.
Though long ago it passed through you!

Verne N. Rockcastle

* Amedeo Avogadro was an Italian scientist who lived from 1776 until 1856.

OTHER RESOURCES

GRADES:

4-8 The Watercourse and Council for Environmental Education, 1995, Water Works: Project WET, pp. 274-278.
Create waterweb to illustrate interdependence between water users and producers.

6-8 The Watercourse and Council for Environmental Education, 1995, A Drop in the Bucket: Project WET, pp. 238-241.
Estimate and calculate percent of available fresh water on Earth.

THE HYDROLOGIC OR WATER CYCLE

Hydrology is the study of the movement of water on the earth's surface, under the ground and in the atmosphere. Although the form of water changes from liquid to solid to vapor, the amount of water on earth remains the same.

Water moves or circulates through a system called the hydrologic or water cycle. Each part of the hydrologic cycle shares a portion of the total water on earth. Water is stored in three areas within the hydrologic cycle:

- in the atmosphere as water vapor in the clouds
- in surface water such as lakes and rivers
- in the ground as groundwater

It moves in and out of these areas by:

- precipitating from the atmosphere
- infiltrating into the ground
- evaporating from surface water and soil
- transpirating from vegetation (Janowicz, et. al., 1991)

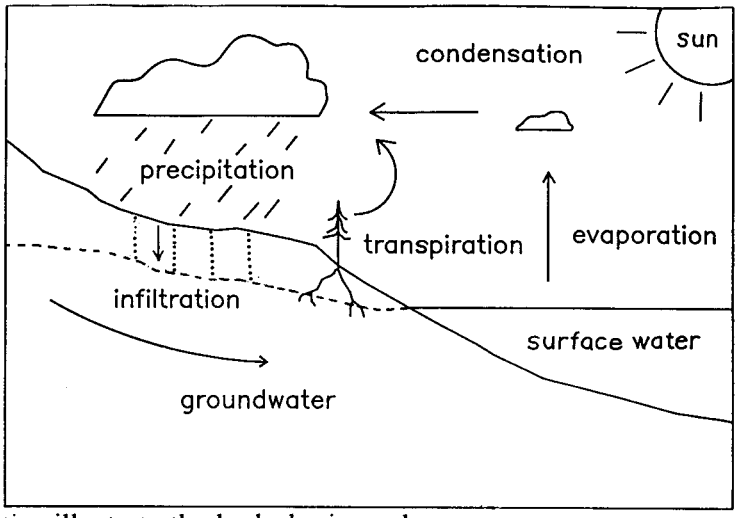
Because each component of the hydrologic cycle is related, actions that take place in one part can affect another, including the travel of pollutants.

Water Facts:

- One inch of rain falling on 1 acre of ground is equal to about 27,154 gallons and weighs about 113 tons.
- Four to 5 inches of heavy wet snow or 20 inches of dry powdery snow equals about 1 inch of water.
- Water flowing at the steady rate of 1 gallon per minute is equal to 1,440 gallons per day.

(adapted from U. S. Geological Survey)

THE HYDROLOGIC CYCLE



The following activities illustrate the hydrologic cycle.

ACTING THE WATER CYCLE

GRADES: 2-5
SUBJECT: Drama, Science
SKILLS: Analyzing, applying, communicating, describing, discussing, identifying, listening, observing, role playing, small group work, visualizing
DURATION: 1 hour
SETTING: Indoor or outdoor
KERA ACADEMIC EXPECTATIONS: 1.2, 1.3, 1.4, 1.15, 2.3, 4.2, 5.2, 6.1, 6.3

OBJECTIVE:
To be able to identify each part of the hydrologic cycle.

METHOD:
Play a game of charades.

MATERIALS NEEDED:
None

PROCEDURE:

- Divide class into 5 or more groups.
- Secretly tell each group its role in the hydrologic cycle:
  - sun
  - surface water
  - evaporation
  - atmosphere
  - precipitation
  - groundwater
  - infiltration
  - transpiration
- Have each group devise actions and sounds that fit their role.
- Each group acts out its part while the rest tries to guess what they are and what part of the cycle they belong in.
- When all groups have performed, arrange the groups in a cycle and follow a drop of water through the cycle as each group takes a turn acting out its action and sound.

EVALUATION:
This activity reinforces knowledge of the various parts of the hydrologic cycle and how the parts interact.

- What are the parts of the hydrologic cycle? (surface water, evaporation, atmosphere, sun, infiltration, precipitation, groundwater, transpiration)
- What are some ways that water can move through the cycle? (example: evaporation from lake to cloud, rain falls into lake)

(adapted from Hirschland, 1992)

WHAT COMES AROUND...GOES AROUND

GRADES: 4-8*
SUBJECTS: Art, Science
SKILLS: Discussing, drawing or matching, visualizing
DURATION: 30 minutes
SETTING: Indoors
KERA ACADEMIC EXPECTATIONS: 1.3, 1.4, 1.7, 2.3, 2.4, 3.7, 5.3, 6.1, 6.2, 6.3

OBJECTIVE:
To gain an understanding of how each part of the hydrologic cycle can affect another.

METHOD:
Draw and label the hydrologic cycle.

MATERIALS NEEDED PER STUDENT:

- Paper
- Pencil, crayons, colored pencils, or markers

PROCEDURE:

- Draw a diagram showing the parts of the hydrologic cycle and label the parts:

Infiltration	Surface water
Groundwater	Evaporation
Transpiration	Precipitation
Atmosphere	Sun

EVALUATION:
This activity shows how water in the various components of the hydrologic cycle is connected and related.

- What are the parts of the hydrologic cycle?
- What are some ways that water can move through the cycle? (example: evaporation from lake surface to atmosphere, rain precipitates to ground, runs off to lake)

EXTENSION:
Show where pollution can enter and how it travels through the cycle.

- At what points can pollution enter the cycle? (through the soil, air, water)
- What are some ways that pollution moves through the cycle? (example: air pollution forms acid rain which precipitates into lake lowering pH of lake)

* For Grades K-3 make a large diagram of the hydrologic cycle and match the names to the diagram.

(Adapted from The GEM Program)

WATCH WATER CYCLE

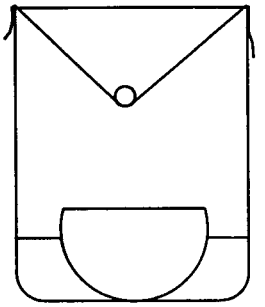
GRADES: K-A
SUBJECT: Science
SKILLS: Analyzing, discussing, experimenting, observing, small group work, visualizing
DURATION: 30 minutes to set up, a few hours or overnight for evaporation to take place
SETTING: Indoors or outdoors
KERA ACADEMIC EXPECTATIONS: 1.3, 2.3, 2.4, 4.2, 5.3, 6.3

OBJECTIVE: To observe evaporation, condensation, and precipitation.

METHOD: Make a model of the hydrologic cycle.

MATERIALS NEEDED PER GROUP:

- Bottom of a clear plastic soda bottle
- Small cup
- Plastic wrap
- Small weight
- Tape or rubberband
- Marker
- Water



PROCEDURE:

- Have an adult cut the top third off the soda bottle, saving the bottom.
- Divide the class into groups, give each group the materials needed.
- Place empty cup right side up in bottle.
- Pour water into bottle until it surrounds the cup, but cup does not float.
- Mark water level with piece of tape or marker.
- Cover and seal bottle with plastic wrap - allowing wrap to sag in the center (use tape or rubberband to seal wrap if needed).
- Place small weight in the center of the wrap over the cup.
- Set the bowl in the sun for a few hours and observe the changes that occur.

EVALUATION: This activity demonstrates evaporation from the water surface, condensation on the plastic wrap, and precipitation into the cup.

- What happened to the water level in the bottle? (Went down)
- Where did this water go? (Evaporated)
- What formed on the plastic wrap? (Condensation)
- Where did the water in the cup come from? (Condensation slid down plastic wrap and precipitated into cup)

EXTENSION: Add salt to the water in the bottle when setting up model. This demonstrates how fresh water can form from salt water.

- Does the water in the cup taste salty? (No)
- What happened to the salt? (Crystallized on the sides of the bottle)

(adapted from Hirschland, 1992)

TRANSPIRATION IN PLANTS

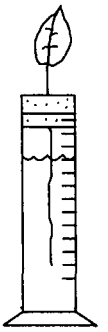
GRADES: 6-A
SUBJECT: Science, Math
SKILLS: Analyzing, comparing, experimenting, measuring, observing, small group work
DURATION: 30 minutes to set up, observe for a week
SETTING: Indoor
KERA ACADEMIC EXPECTATIONS: 1.3, 1.8, 2.2, 2.3, 2.10, 4.2, 6.1, 6.3

OBJECTIVE:
To observe the process of transpiration.

METHOD:
Measure the amount of water lost through a leaf due to transpiration.

MATERIALS NEEDED PER GROUP:

- Graduated cylinder OR large test tubes or vials with a metric ruler taped to side
- Cork or stopper with hole for plant stem (stem must fit snug to prevent evaporation of water through opening)
- Cutting from a large leaf plant (example: coleus)
- Water
- Fan (one needed for class)



PROCEDURE:

- Fill cylinder with water.
- Push cutting through hole in stopper and cut off end of stem.
- Insert stopper into cylinder, stem must extend well below water line.
- Record water level.
- Place cylinders in sun, shade, and in front of fan (breeze should not disturb plant).
- Record water level every day for a week.

EVALUATION:
This experiment demonstrates that water evaporates from leaf surfaces, and evaporates at different rates in different environments.

- What happened to the water level in the cylinder? (went down)
- Where did the water go? (absorbed by the plant roots, transpirated through leaves)
- In which environment was the rate of transpiration fastest? Why?
- In which environment was the rate of transpiration slowest? Why?

(adapted from National Vocational Agriculture Teachers Association)

A CONDENSED DEMONSTRATION

GRADES: 2-A
SUBJECT: Science
SKILLS: Analyzing, comparing, discussing, experimenting, observing, small group work, visualizing
DURATION: 1 hour
SETTING: Outdoors, suitable for use in an outdoor classroom
KERA ACADEMIC EXPECTATIONS: 1.3, 2.3, 4.2, 5.3, 6.2, 6.3

OBJECTIVE:
To demonstrate evaporation, transpiration, and condensation.

METHOD:
Observe evaporation, transpiration, and condensation from various ground surfaces.

MATERIALS NEEDED PER GROUP:

- Plastic wrap
- Pebbles, sticks
- Sunny day

PROCEDURE:

- Divide group into 4-5 smaller groups, give each group the materials needed.
- Assign each group a different ground surface (not in an area where cars or people will travel over it) such as:

bare ground	asphalt	sand
grass	mulch	
concrete	gravel	

- Lay a strip of plastic wrap over the selected ground surface, secure with pebbles or sticks.
- After about 30 minutes observe the changes that have occurred.

EVALUATION:
This activity demonstrates how water evaporates or transpirates from various ground surfaces, then condenses.

- What formed on the plastic wrap? (Condensation)
- Where did it come from? (Water evaporated from the ground or transpirated from the vegetation)
- What sites showed the most condensation, the least, or none at all?
- Why was there a difference? (Differing amounts of moisture in the ground surfaces)

(adapted from Hirschland, 1992)

OTHER RESOURCES

GRADES:

K-5 Chilton-Stringham, Patricia A., 1992, Henry Goes Underground: Kalamazoo Cooperative Extension Service Groundwater Education Program and Western Michigan University Institute for Water Sciences' Groundwater Education in Michigan (GEM) Regional Center, 32pp.
Follow a drop of water through the water cycle.

K-8 Western Regional Environmental Education Council, 1987, Aqua Words: AQUATIC Project WILD, pp. 1-2.
Brainstorm water words, create word trees, then write poetry about water.

4-8 American Forest Foundation, 1994, Water Wonders, Part A: Project Learning Tree, Pre K-8 Activity Guide, p. 142-147.
Water cycle activity.
The Watercourse and Council for Environmental Education, 1995, Imagine: Project WET, pp. 157-160.
Imaginary journey through the water cycle.
_____, The Incredible Journey: Project WET, pp. 161-165.
Action game simulating the movement of water within the water cycle.
_____, Water Models: Project WET, pp. 201-205.
Construct models of the water cycle.

5-9 Western Regional Environmental Education Council, 1987, Water Wings: AQUATIC Project WILD, pp. 3-6.
Experience guided imagery and create artwork and poetry.

6-8 The Watercourse and Council for Environmental Education, 1995, Thirsty Plants: Project WET, pp. 116-121.
Transpiration in plants

7-A Lieblich, Suzanne, ed., 1995, The Water Cycle - Model A: National Science Teachers Association/DuPont, Understanding Our Environment Series, Water, p. 10.
Build a working model of the hydrologic cycle.